Transportation Options Reducing California Greenhouse Gas Emissions

Greg Dierkers, Senior Policy Analyst
Center for Clean Air Policy

Briefing to the Interested California Stakeholders

San Francisco, California
April 6, 2005

Overview

- Introduction to sector emissions
- Review of policies for analysis
  - » Alternative fuels and vehicle technologies for heavy duty vehicles (HDVs) and light duty vehicles (LDVs)
  - » freight, smart growth and aviation/high speed rail (HSR)
- Next steps for analysis, policies for further consideration
- IEPR updates

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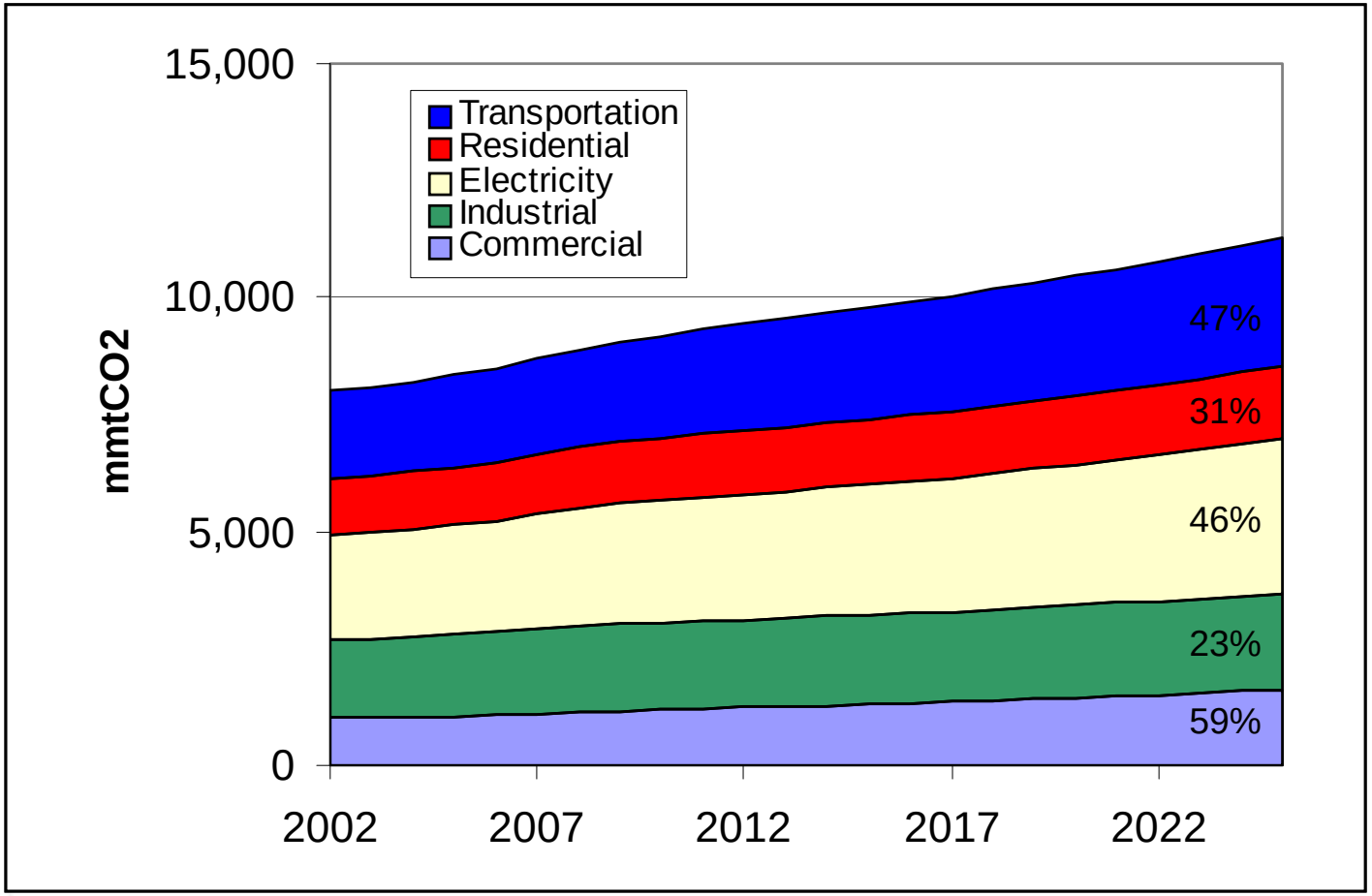
Transportation: Second Fastest Growing CO_2 Source in U.S



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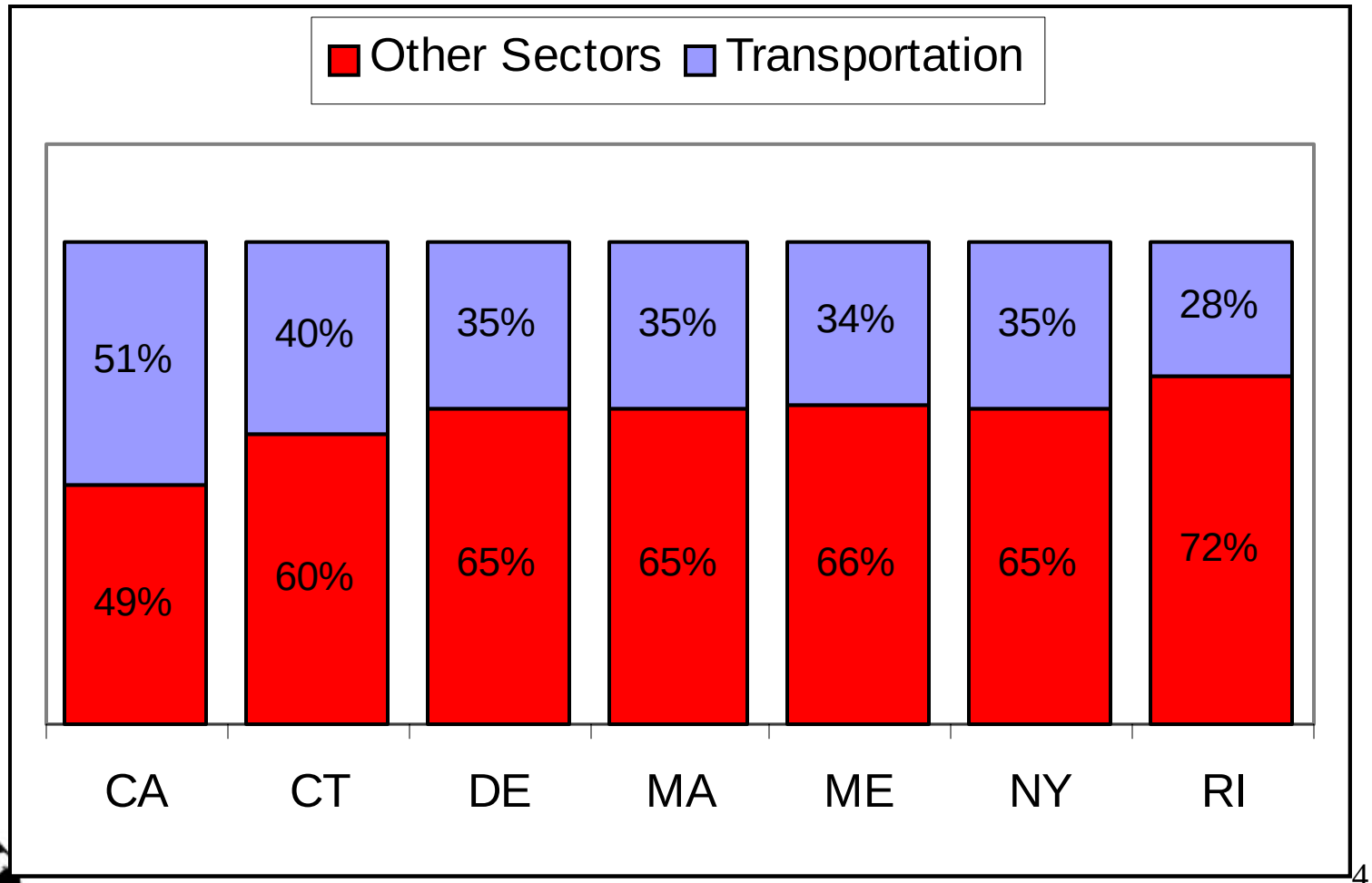
Source EIA 2005 Annual Energy Outlook

Comparison of State Transportation Emissions (% of total)



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Transportation GHG Emissions for California

- In 1999, state transportation GHGs were **210 MMTCO$_2$**
  - Includes gasoline, jet fuel, diesel, LPG, lubricants, aviation gasoline and high intensity GHGs (N_20 and CH_4),
- Transportation mobile sources from gasoline, jet fuel and diesel fuel are lion's share
  - 1990: 186 MMTCO2e
  - 1999: 210 MMTCO2e
  - 2010: 247 MMTCO2e
  - 2020: 287 MMTCO2e
- Growth rate of almost 40% between 1999 and 2020

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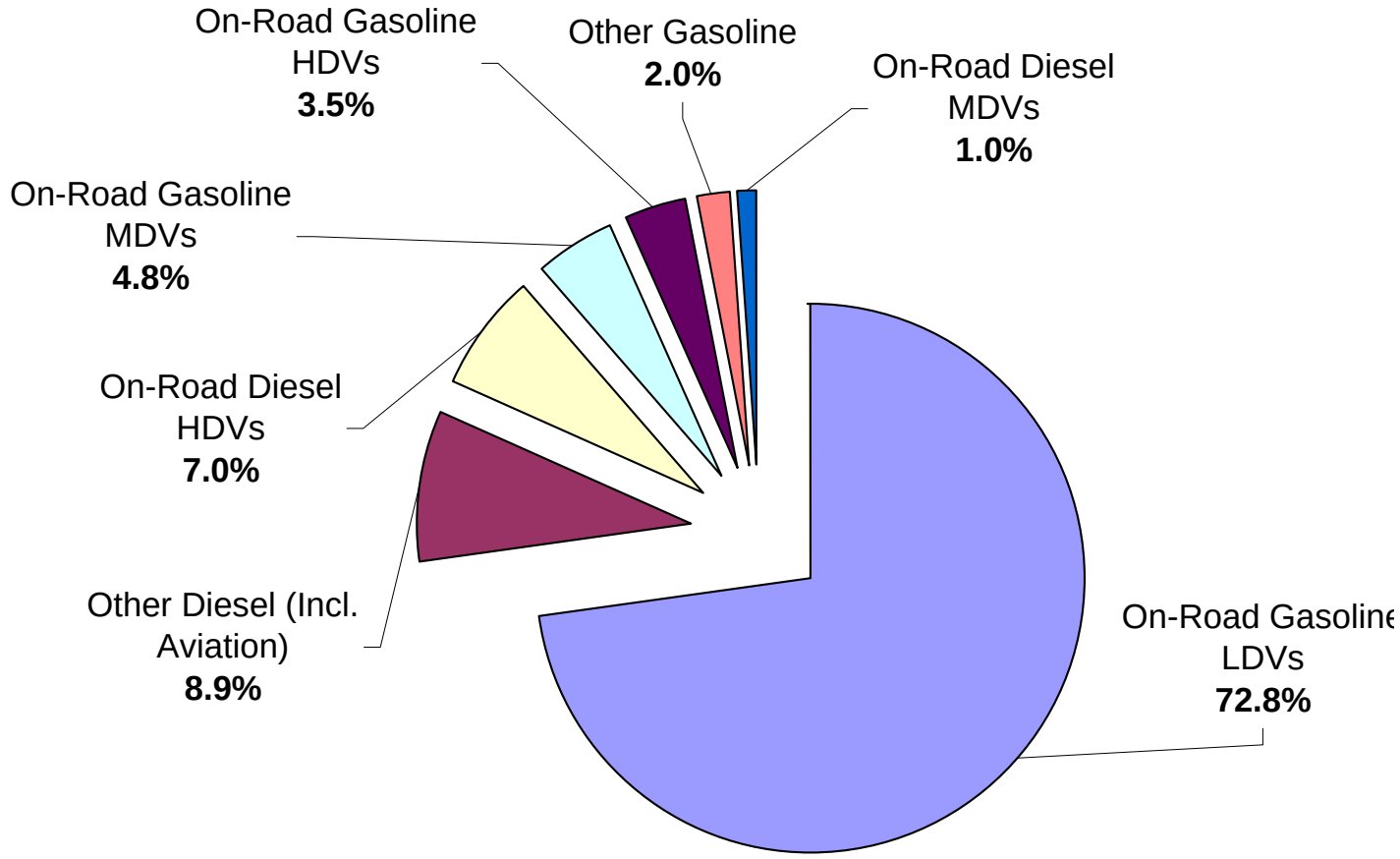
CA 1999 Transportation GHG Emissions



Source: California Energy Commission, 2004.

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Summary
Estimated Transporation Sector GHG Reductions in California

Program or Policy	Emissions Reductions (MMTC02e)
Preliminary Analysis	**Est. or Range**
Pavley GHG Vehicle Standards	34.9
HDVs (expanded Alternative Fuels, Efficiency & Hybrids)	3.81 - 6.91
Ethanol (10% gas/ethanol blend; FFVs using 85% ethanol)	8.66 - 28.36
Soybean-based Biodiesel (50% of diesel contains B20)	4.30
Freight & Port (TSE, Anti-idling, Cold Ironing)	2.91 - 9.64
VMT Reduction (MPOs Regional Plans)	5.49
Aircraft modifications	5.89
Other Measures to Be Considered	
Feebate program	TBD (~34)
Plug in Hybrid Vehicles	TBD
Pay As You Drive Insurance	TBD
Rail (freight and passenger)	TBD
Total *(includes High values when range is provided))*	***95.49***
% above CA 1990 Transportation Baseline (1990 = 186 MMTCO2)	*15.3%*
Net 2020 MMTCO $_2$ (BAU 310)	*215*

Source: CCAP based on CEC GHG projections
MMTCO2e = Million Metric Tons of Carbon Dioxide Equivalent

Heavy, Med. Duty Vehicle (HDVs & MDVs): **CNG, LNG, Hybrids**

- Policy: Alternative fuels (AF), truck efficiency, gasoline-hybrid (HEV) technology by 2020
  - » HDVs & MDVs are > 8500 lbs (>15% of CA GHGs)
  - » **Low Scenario** = 3.8 $MMTCO_2$
    - – Fuels (20% GHGs savings in 5% of fleet)
    - – Efficiency (10% GHG savings in 10% of fleet)
    - – HEVs (30% GHG savings in 50% of fleet)
  - » **High Scenario** = 6.91 $MMTCO_2$
    - – Fuels (20% GHG savings in 15% of fleet)
    - – Efficiency (20% GHG savings in 50% of fleet)
    - – HEVs (30% GHG savings in 75% of fleet)

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Est. MDV, HDV GHG Savings in 2020

Summary MDV & HDV Trucks (2020 MMTCO2 Savings)		
Range	**Low**	**High**
Alternative Fuels Penetration (CNG, LPG)	5%	15%
Gallons of Diesel Saved (M)	385	769
AFV HDVs	30,776	61,552
MMTCO2	**0.78**	**1.56**
Truck Efficiency Penetration (retrofit & new)	10%	50%
MDVs and HDVs (Class 3-6)	56,125	280,626
HDVs (Class 7-8)	2,832	14,162
MMTCO2	**1.43**	**2.96**
Technology Penetration (new gasoline-hybrids)	50%	75%
Gallons of Gasoline Saved (M)	195	293
HEV MDV Gasoline Vehicles	123,401	185,101
MMTCO2	**1.59**	**2.39**
% CA diesel displaced	14%	28%
% CA gasoline displaced	1.0%	1.5%
TOTAL MMTCO2 Reduction	**3.81**	**6.91**

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Heavy, Med. Duty Vehicle (HDVs & MDVs): **Biodiesel (BD)**

- Policy: Soy-based biodiesel in diesel HDVs
- 75% BD2 in 2010, 50% BD20 in 2020
  - » Almost 500K vehicles, 10% CA Diesel reduction
  - » Uncertainty about GHG savings, NOx concerns
  - » Preliminary Savings: **4.30 MMTCO$_2$**

Bio-diesel (BD) Use in California, 2010, 2020					
Year	CA Diesel	Gallons of Diesel	CA Diesel Displaced	HDVs using BD	MMTCO2
2010		75% B2		75% B2	
	3,300,000,000	49,500,000	2%	617,401	0.55
2020		50% B20		50% B20	
	3,846,991,500	384,699,150	10%	492,310	**4.30**

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Heavy, Med. Duty Vehicle (HDVs & MDVs): Summary of GHG Savings

- 2020 Maximum Savings: 11.21 $MMTCO_2$
  - » Over 1/3 of CA diesel fuel displaced
  - » Based on alternative fuel industry projections, CEC efficiency estimates and high technology penetration
  - » Lifecycle GHG savings
- Implementation
  - » Fuels: Focus should be centrally fueled or large fleets
  - » Efficiency: Voluntary programs (e.g., EPA's Smartway Program) & expanded incentives (i.e., Carl Moyer)
  - » HEVs: operator training pilot programs in Canada
    - – reductions of 20 -30% from technology, driver training packages

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GHG Saving from LDV Alternative Fuel Use (cars and trucks)

Lifecycle GHG emissions (gram/mile)					
Light Duty Fleet = Cars and Trucks < 8500 lbs (assumes 62 - 38 car vs. LT split)	Feedstock or Fuel Production	Fuel Use	Vehicle Operation	Total	GHG savings vs. gasoline
Conventional Gasoline	**34.8**	**84.5**	**451.1**	**570.4**	**100%**
Fed RFG	34.8	85.5	450.7	571.0	100%
CA RFG	31.4	94.6	425.1	551.1	97%
CIDI Diesel	28.4	50.7	387.6	466.8	82%
CNG	60.8	35.8	389.7	486.4	85%
LPG	21.0	33.0	369.0	423.0	74%
FFV Ethanol (Corn)	-199.0	215.3	429.4	445.7	78%
FFV Ethanol (Herb Biomass)	-240.9	23.7	429.4	212.2	37%
FFV Ethanol (Wood Biomass)	-332.2	28.4	429.4	125.7	22%
EV (Btu/Mile)	24.7	370.7	0.0	395.4	69%
Source: CCAP from Transportation Energy Data Book, Oak Ridge National Laboratory, GREET model version 1.6 beta, 2003, http://www.transportation.anl.gov/greet/ GHG emissions = CO2, N20 & CH4					

Hydrogen = can have significant GHG reductions but depends on source.

Source: CCAP from Transportation Energy Data Book, Oak Ridge National Laboratory & GREET model version 1.6 beta, 2003

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Alternative Fuel Use in Light Duty Vehicles (LDVs)

- Policy: LDV ethanol/gasoline blends
  - » Low Scenario: 5.7% gasoline blend, 5% Flexible Fuel Vehicles (FFVs) use E85
    - – E-85 is 85% ethanol blended w/ 15% gasoline (Ford Taurus)
  - » High Scenario: 10% blend, 25% E-85 use by 2020
- 2020 savings
  - » Based on FFV fleet and feedstocks projections
  - » Low Range for corn & cellulose (7.6 - 17.8 $MMTCO_2$)
  - » High Range for corn & cellulose (8.7 - 28.4 $MMTCO_2$)

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LDV GHG Savings: Corn, Cellulosic Ethanol

Expanded Ethanol Use in California (2010, 2020)				
Year	**CA RFG**	**CA FFVs using E-85**	**MMTCO2e**	
	5.7% vol	5% of CA FFVs (21K vehicles)	corn	cellulosic
Low	879,000,000	47,812,500	7.58	17.83
	10% vol	25% of CA FFVs (75K vehicles)		
High	1,757,000,000	168,750,000	8.66	28.36

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GGE = Gasoline Gallon Equivalent. Approximately 1.2 gallons of ethanol are required to replace 1 gallon of gasoline.

LDV GHG Savings from Ethanol

- Implementation Issues
  - » CA Production: 30M gal of ethanol/yr (< 10% of supply)
    - – High $/MMTCO$_2$: costly infrastructure, cellusolic may necessitate incentives, pilot programs
    - – link with West Coast supplies, consider other imports
  - » GHGs, air quality: CAFE credits for FFVs may increase US GHGs; ethanol volatility may increase NOx
- Follow Minnesota's lead?
  - » 10% ethanol, legislation to expand to 20% statewide
    - – Includes expanded vehicle warranties for higher level blends to mitigate air quality concerns, maximize GHG benefits

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Alternative Fuels Next Steps

- Adjust estimates based on IEPR analysis
- Expand list of technologies, penetration rates
  - » HDV = more detail on FedEX HEV technology, address transit, buses)
  - » LDV = analysis of plug-in HEVs, hydrogen
- Develop more detailed matrix, w/ costs
- Expand implementation ideas
  - » Federal AF programs, Clean Cities, etc.
  - » Review voluntary programs & pilot initiatives in U.S., Europe, Canada

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Freight & Ports GHG Reductions

- Truck traffic anticipated to increase 76% by 2025
- Policy: Diesel truck efficiency improvements
  - » Anti-idling/electrification
    - – Avg. idle diesel fuel consumption for all tractor-trailers is 1500 gallons/year
    - – Assume range of 1% - 10% of HDV trucks are electrified by 2020
  - » Port truck efficiencies
    - – Current engines can achieve a 10% reduction but requires higher temperatures, greater precision, and lighter weight
    - – Rebuilds can achieve > 20% reduction in GHGs but requires new materials for advanced combustion-chamber components, cylinder heads, engine blocks, exhaust systems, etc.

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Freight GHG Reductions

- Low-rolling resistance tires
  - » CEC estimates show up to 350M gal diesel fuel saved
    - – Driver safety, operator training issues
- Port operations (i.e., LA, Long Beach, and Oakland)
  - » Measures taken from CA Electric Transportation Commission (CalETC) Electrification Report, CEC
    - – Trailers, forklifts, yard tractors are up to half of port operations and 40% equipment efficiency improvements achievable, depending on power mix
- Preliminary Savings Scenarios
  - » Low Scenario = 2.91 $MMTCO_2$,
  - » High Scenario = 9.64 $MMTCO_2$

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2020 Truck and Port GHG Reductions

Low GHG Freight: Anti-Idling, Trucks, Ports (2020 MMTCO2)				
Truck Programs	**Gallons of Diesel Saved**	**Low**	**Gallons of Diesel Saved**	**High**
Anti-Idling of Trucks	81,500,000	0.83	326,000,000	3.31
Port Trailer Efficiency	10,000,000	0.10	184,000,000	1.87
Full Tire Inflation	150,000,000	1.52	350,000,000	3.55
Port Programs				
Electric Refrigerated Trailers	30,000,000	0.30	60,000,000	0.61
Electrification of Port Operations (i.e., forklifts)	15,000,000	0.152	30,000,000	0.304
Diesel displaced (M gallons)	**286,500,000**		**950,000,000**	
Total (% CA diesel savings/MMTCO2)	**7%**	**2.91**	**25%**	**9.64**

Sources/Studies Reviewed:
ICF Consulting Report on Truck Efficiency, 2000; Truck Programs: CEC 2003 Petroleum Reduction Study; Port Operations: Cal ETC Study for 2010-15, adjusted for 2020.

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Freight GHG Reductions / Next Steps

- Next Steps
  - » Quantify potential for shifting trucks to rail (i.e., 5, 10%?)
  - » Analyze ship to shore electric power (called cold-ironing)
    - – Look at specific power power mix, ship fleet in CA
- Implementation: How will LA achieve cap on 2001 port emissions levels?
  - » LA Task Force preliminary plan with 65 methods to cut pollution (e.g., replacing older trucks, ultra-low sulfur diesel use in ships, expanded shore power)
  - » ARB's goods movement study, work group materials

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Smart Growth

- VMT in CA growing at over 1.8%/yr
- Policy: VMT Reduction
  - » Review of MPO Transportation Plans for Sacramento, Monterrey Bay, San Fran, LA, San Diego, 10 other areas (~90% of CA VMT)
  - » Modeled VMT savings were applied to CA's large urban areas ranging from 0.1% -10% vs. 2020 business-as-usual
  - » Statewide 2020 Savings: **5.49 MMTCO$_2$**
- How can CA encourage implementation?
  - » How to help MPO's secure funding via public-private partnerships, road-tolling, statewide bonds, etc.
  - » BTH-sponsored legislation to amend CEQA to spur infill and ixed-use

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Source: CA MPO Study, Parsons, 2001 & CCAP.

Aviation and High Speed Rail

- Aviation emissions growing 78% from 2010 -2020
- Policy: Airplane add-on technologies/operations
  - » Aerodynamics, routing, maintenance, weight, winglets
  - » Preliminary 2020 Savings: **5.89 MMTCO$_2$**
- Implementation
  - » Clarify legal implications (i.e., what can CA do vs. FAA?)
  - » ICAO study provides case studies on implementation
- HSR rail analysis
  - » Will show scenario shifts from air to rail & GHG savings from proposed HSR network

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Next Steps for Analysis

- **LDV class-based GHG fee-bates**
  - » Review recent paper/work by David Greene et al.
  - » Work with UC University System to develop straw proposal
- **Cold Ironing analysis w/ PG&E, MJ Bradley**
- **LDV Alternatives**
  - » **Plug-in HEVs** (35% - 65% reduction in GHGs)
  - » LDV Alternatives (dedicated ethanol, hydrogen, car-sharing)
- **Other ideas for consideration**
  - » Expanded TDM, PAYD insurance, GHG-based truck registration fees, carpool allowances, vehicle scrappage?
- **Details on implementation, costs, IEPR**
  - » How to foster incentives, pilots, $/MMTCO2 of strategies
  - » Consistency w/ IEPR & the 2005 Petroleum Reduction Study findings

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